

# INTEX-B (& MILAGRO) Mission Spring 2006

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(White paper <http://cloud1.arc.nasa.gov>)

**GOAL:** To understand the transport, transformation, & impacts of gases & aerosols on air quality & climate from local to global scales

- INTEX-A: Summer 2004
  - large biosphere emissions
  - active photochemistry
- INTEX-B: Spring 2006
  - maximum Asian inflow to NA
  - megacity pollution

MILAGRO



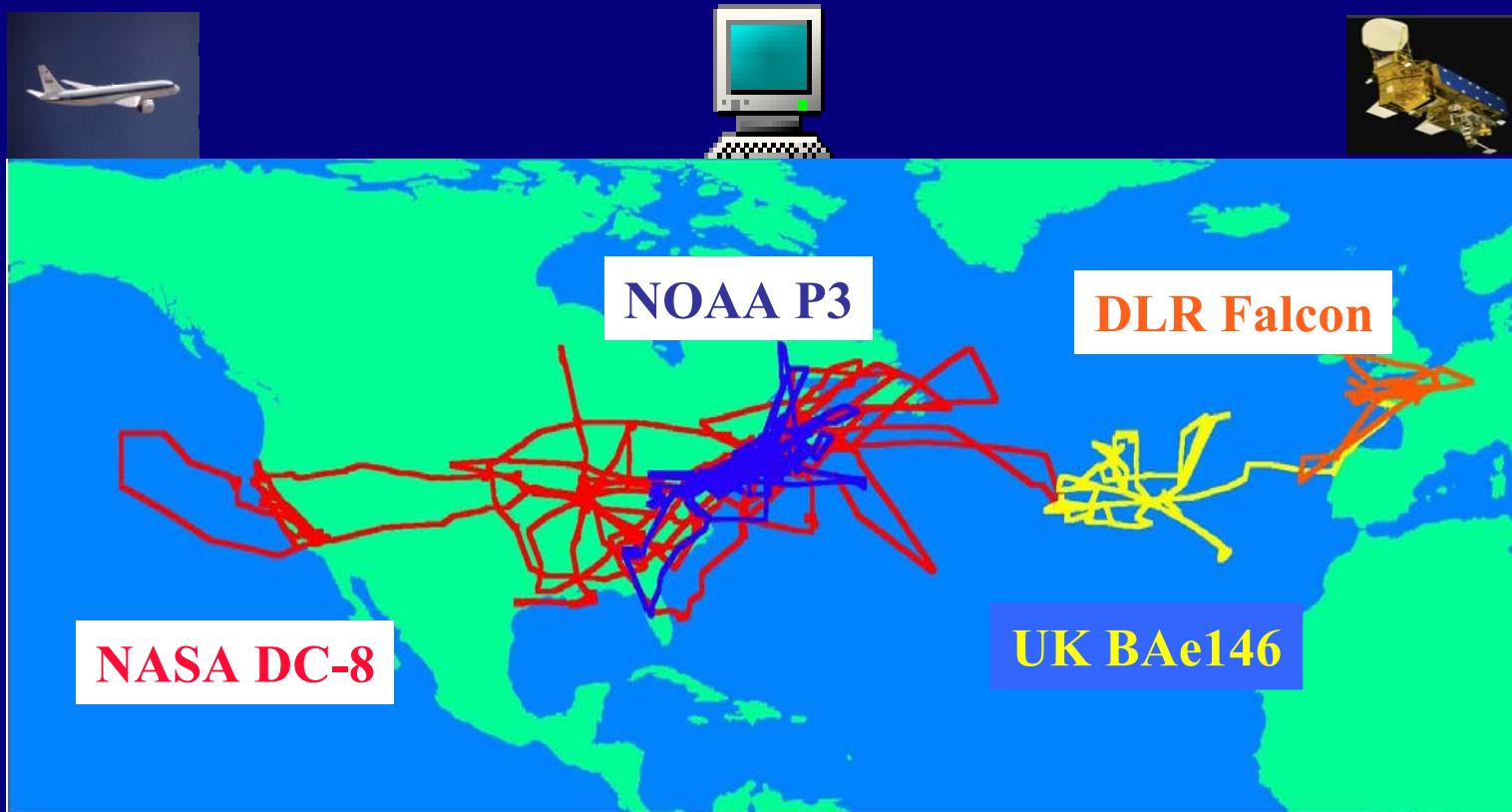
INTEX-B

INTEX-B/2 (IMPEX)  
ITOP

# Outline

- Mission plan & philosophy
- Goals
- Partners
- Airborne platforms & payloads
- Satellites
- Flight plans & coordination

# INTEX-A Plan & Coordination

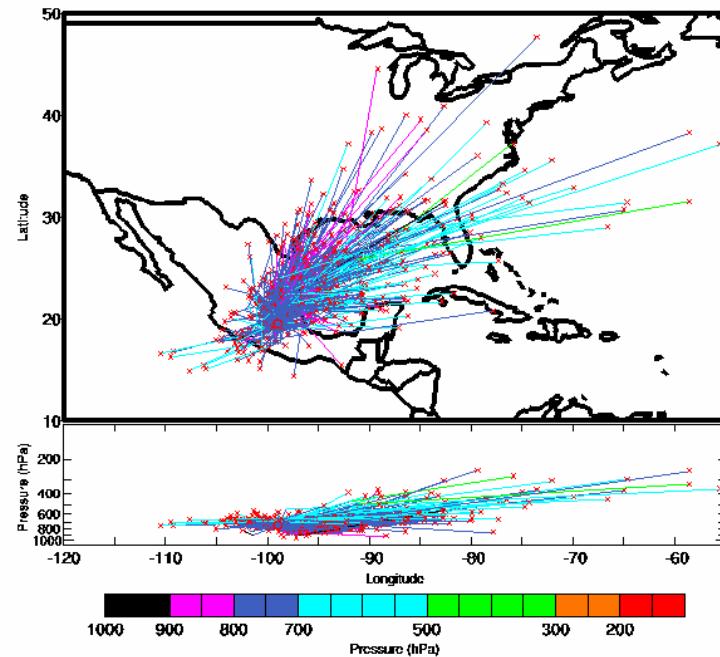


- Inter-comparisons
- Coordinated Science flights
- Sharing of forecasts & data
- Joint publications

## **INTEX-B/MILAGRO SCIENTIFIC GOALS**

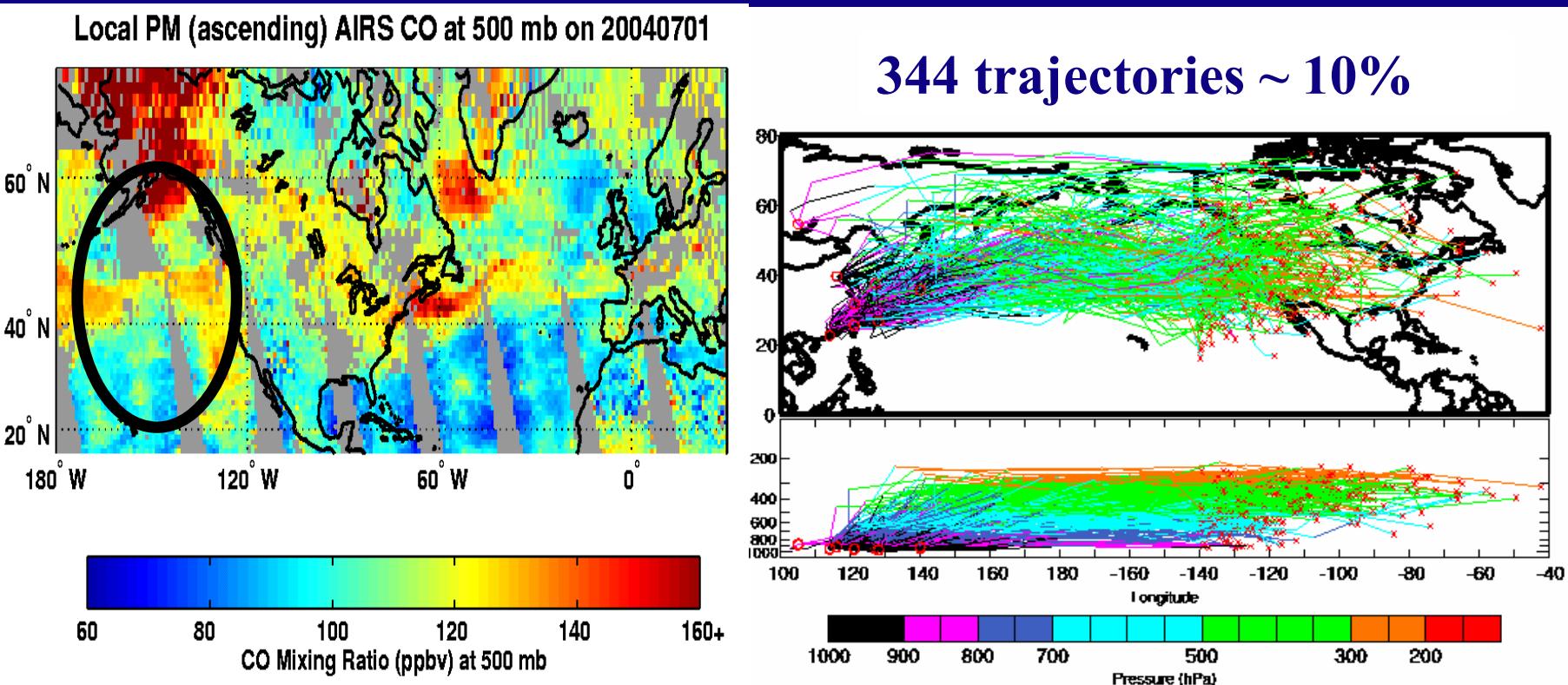
- Transport & evolution of Asian pollution to NA and beyond & implications for regional air quality & climate
- Extent, persistence, & transformation of Mexico City pollution plumes
- Validation of satellite observations of tropospheric composition
- Mapping of anthropogenic and biogenic emissions
- Relating atmospheric composition to sources and sinks
- Quantifying radiative properties and effects of aerosols, clouds, water vapor, & surfaces

# Mexico City Pollution & 3-Day Forward Trajectories



**March Data for 15 years; 33% over US**

# 7-day Forward Asian Trajectories (past 140W)



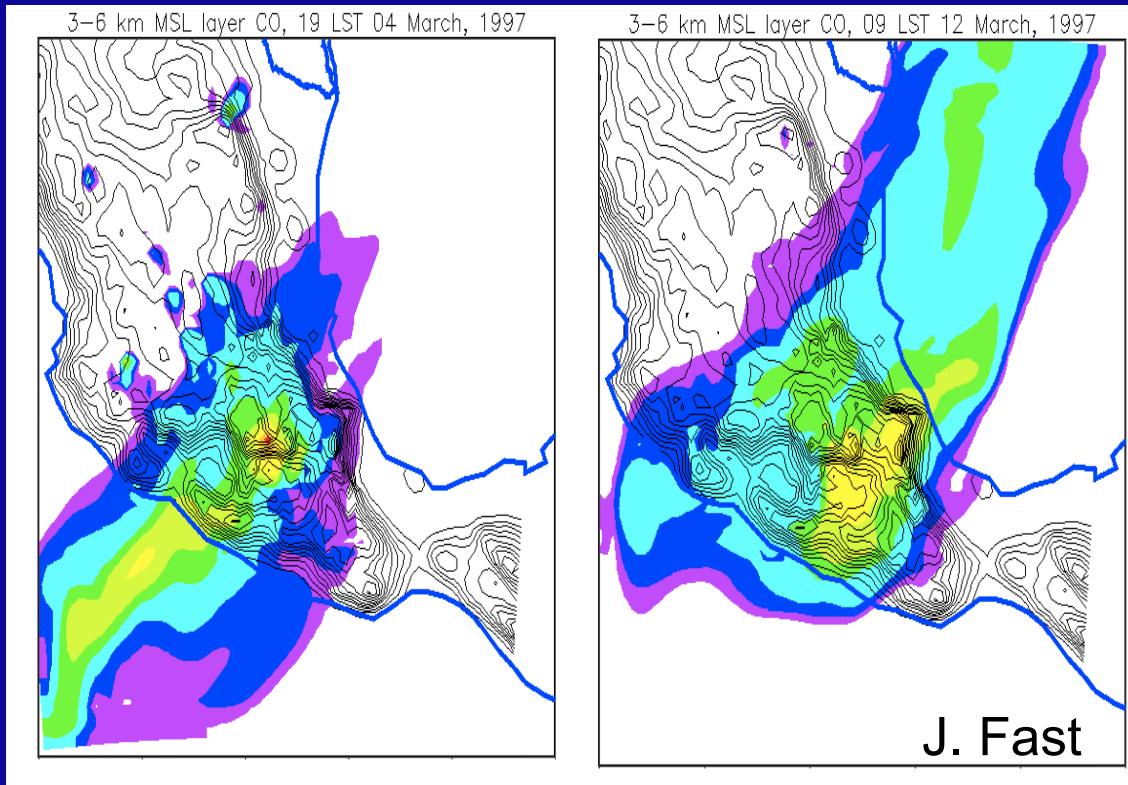
O<sub>3</sub> trend of 0.5 ppb/yr

One Trajectory per day released from  
500 meters AGL from 8 Asian cities.  
April data 15 years

# INTEX-B/MILAGRO Intensive

- **Major Partners:** NASA, NSF, DOE, DLR, Mex, Canada
- **Major Platforms:**
  - **DC-8:** Large scale characterization, inflow/outflow, transport & evolution, satellite validation
  - **C-130/G1/J-31/King Air:** BL & regional characterization, BL/FT exchange, radiation
  - **Falcon-20:** UT/LS processes & exchange, satellite validation
  - **Satellites (Aura/Aqua/Envisat)** : Global coverage of selected species
  - **Ground based:** Sondes, lidars, air quality stations

# Forecasts & Model Products INTEX-B



MET data  
Trajectories  
Convective influences  
Fires

AIRS- CO  
MOPITT- CO  
MODIS- Aerosol  
SCIA- NO<sub>2</sub>  
GOES- clouds

GEOS-Chem (Harvard)  
MOZART (NCAR)  
RAQMS (Langley)  
STEM/CFORS (U. Iowa)  
Other models (e. g. PNL)

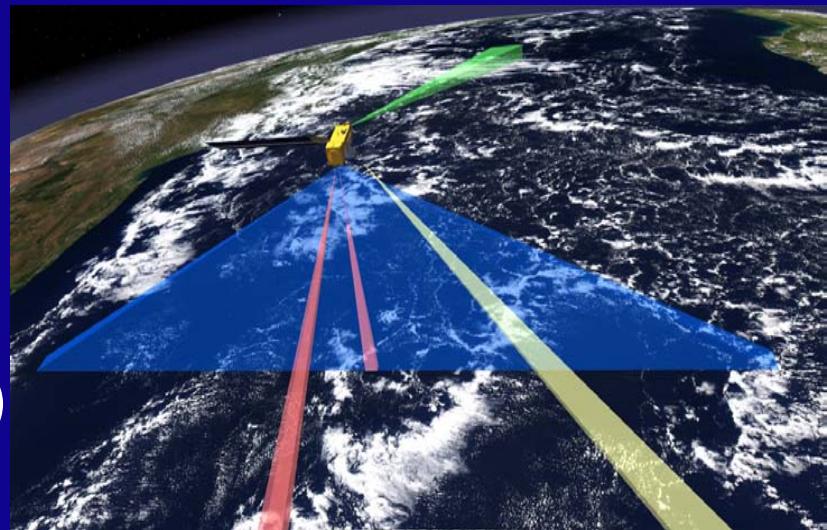
**Global models: 1-5 day forecasts**  
**Regional models: 1-2 day forecasts**  
**Local models: 1 day forecasts**

# INTEX-B DC-8 Satellite Validations

(TES, OMI, MLS, HIRDLS, AIRS, MODIS, MOPITT, MISR, SCIA, Calipso)

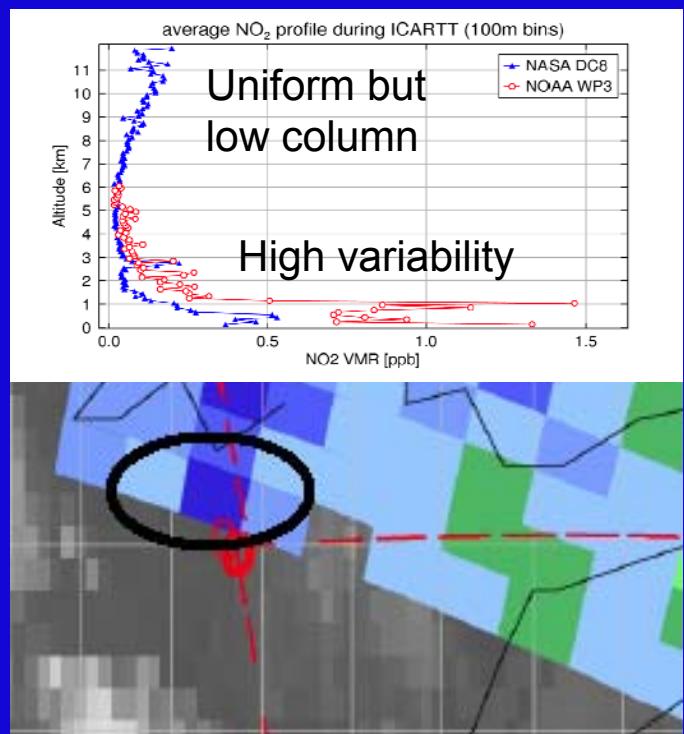
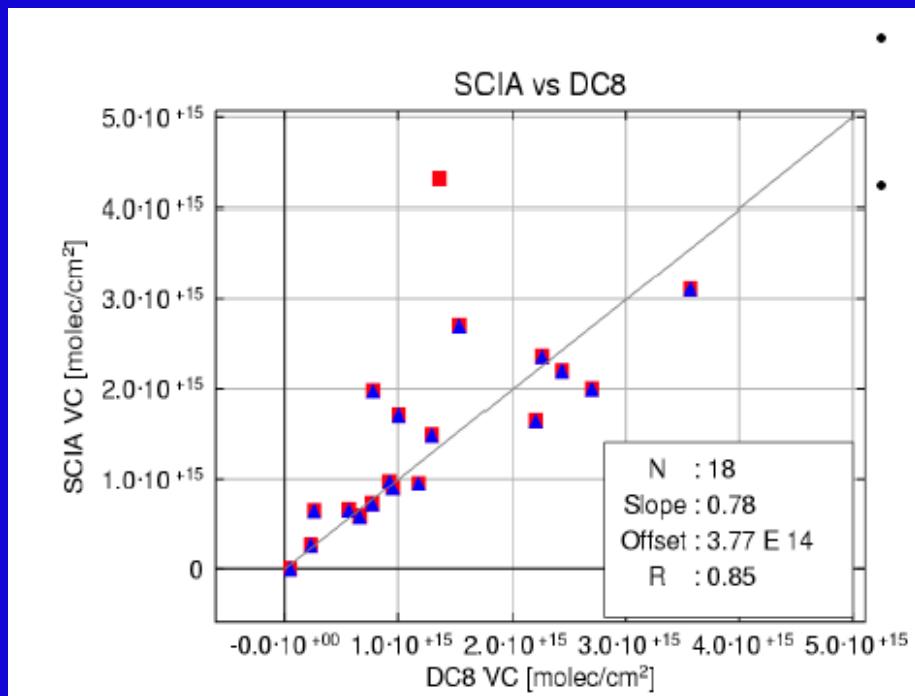
(CO, O<sub>3</sub>, HCHO, NO<sub>2</sub>, Aerosol, HNO<sub>3</sub>, SO<sub>2</sub>, H<sub>2</sub>O, HCN, Organics)

- Coincident along track observations in UTLS & lidar curtains in strat and trop
- Coincident vertical profile in polluted & clean Trop (0-12 km)
- Limb & cross swath observations in UTLS
  - Variety of surface features
  - Cloud free conditions
  - Day and night



- Satellite tracks and instrument swaths to be available for forecasts
- Definition of INTEX-B preferences from TES

# DC-8/SCIAMACHY Trop Column $\text{NO}_2$

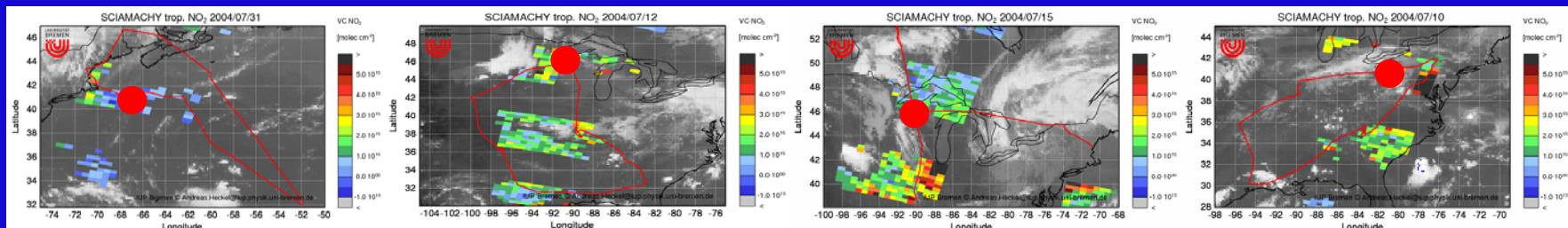


7/31

7/12

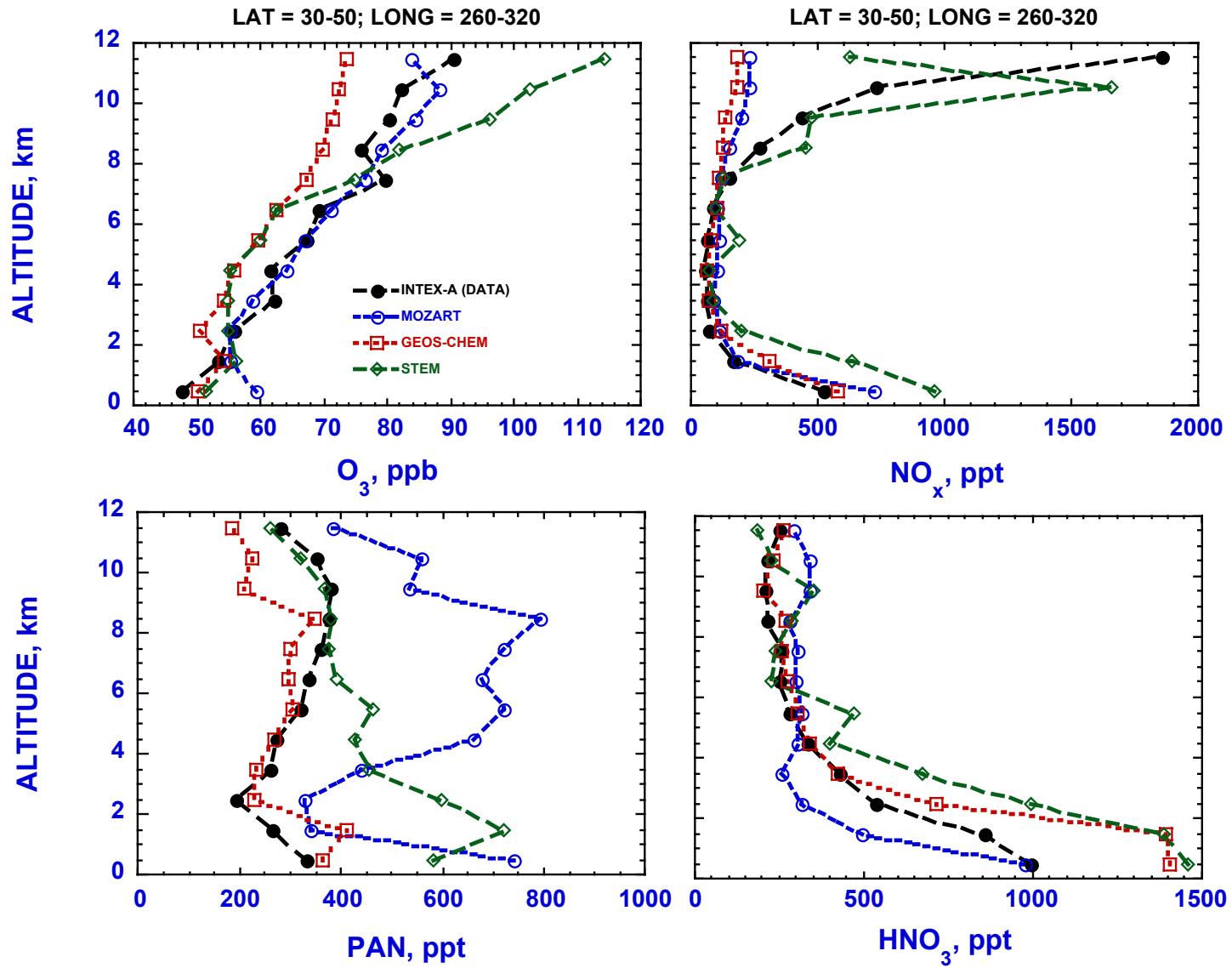
7/15

7/10

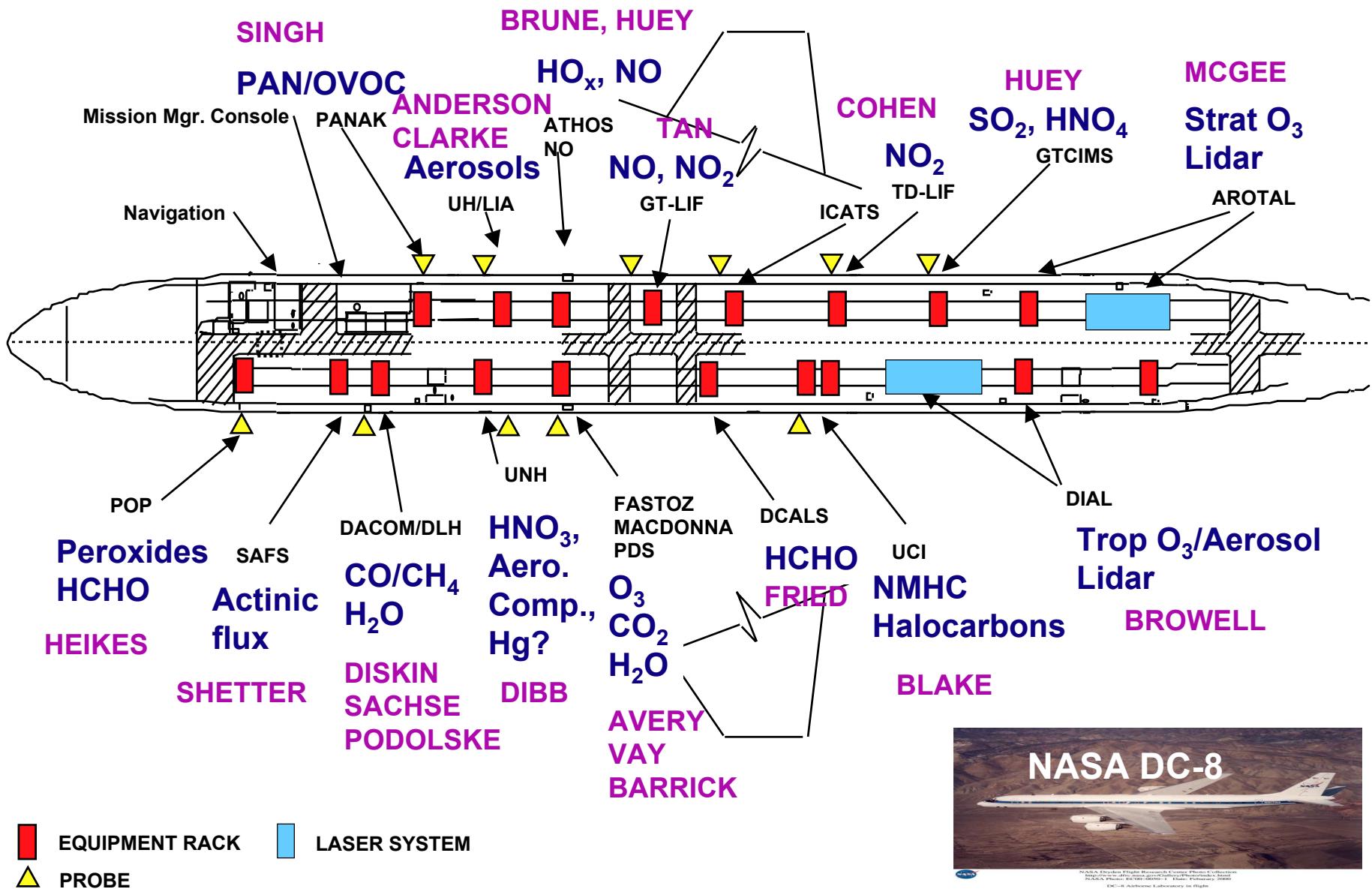


Heckel et al.

# O<sub>3</sub> and Reactive Nitrogen vs models



# DC-8 INTEX-B Payload



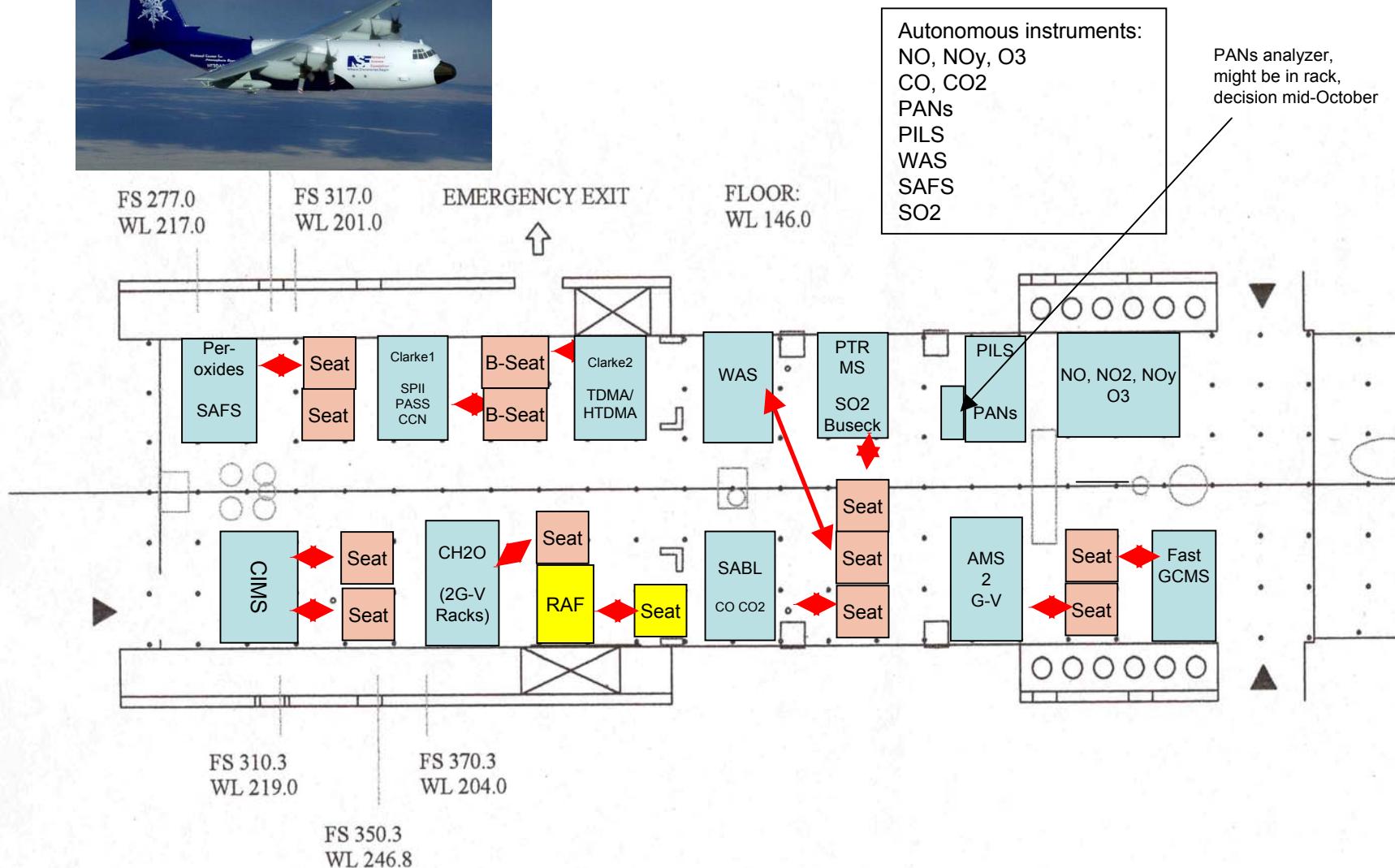
NASA DC-8

NASA Dryden Flight Research Center Photo Collection  
NASA Flight Deck Instrumentation Under University Grant  
DC-8 Airborne Laboratory on Flight



**NSF C-130**

## C-130 LAYOUT FOR MIRAGE



# DLR/Falcon INTEX-B Instrumentation

- **Chemical Measurements**

Gases:

Nitrogen- NO, HNO<sub>3</sub>, NO<sub>y</sub>

Carbon- CO, CO<sub>2</sub>, CH<sub>2</sub>O

Oxidants- O<sub>3</sub>

Sulphur- SO<sub>2</sub>



Aerosols:

Aerosol size distribution ( 0.004 - 20 μm)

volatile/semi-volatile aerosol fraction

- **5+ missions to coincide with INTEX-B/Part 2**

# J31 Layout, INTEX-B/Part 1

Solar Flux  
Radiometer

Cloud  
Absorption  
Radiometer

Sun  
Photometer

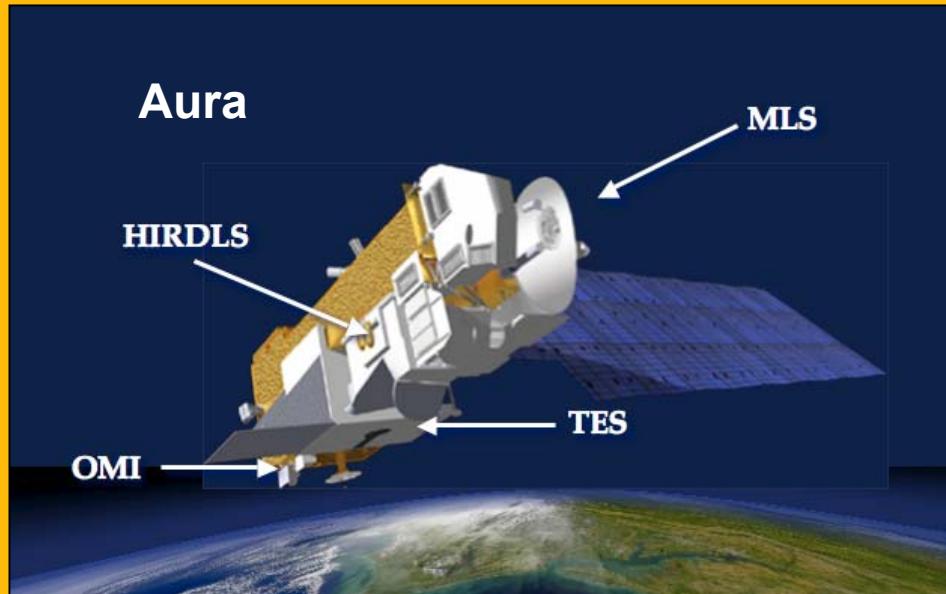
Scanning  
Polarimeter



- Characterize the distributions, radiative properties, and effects of aerosols and water vapor
- Test the ability of satellite sensors & airborne lidar to retrieve aerosol, cloud, and water vapor properties
- Characterize surface spectral albedo and bidirectional reflectance to help improve satellite retrievals
- Quantify relationships between the above & aerosol amount and type

# Satellites & Priority Chemicals

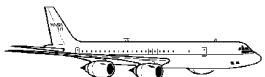
Strat-O<sub>3</sub>  
O<sub>3</sub>, NO<sub>2</sub>, HCHO,  
SO<sub>2</sub>, Aerosol



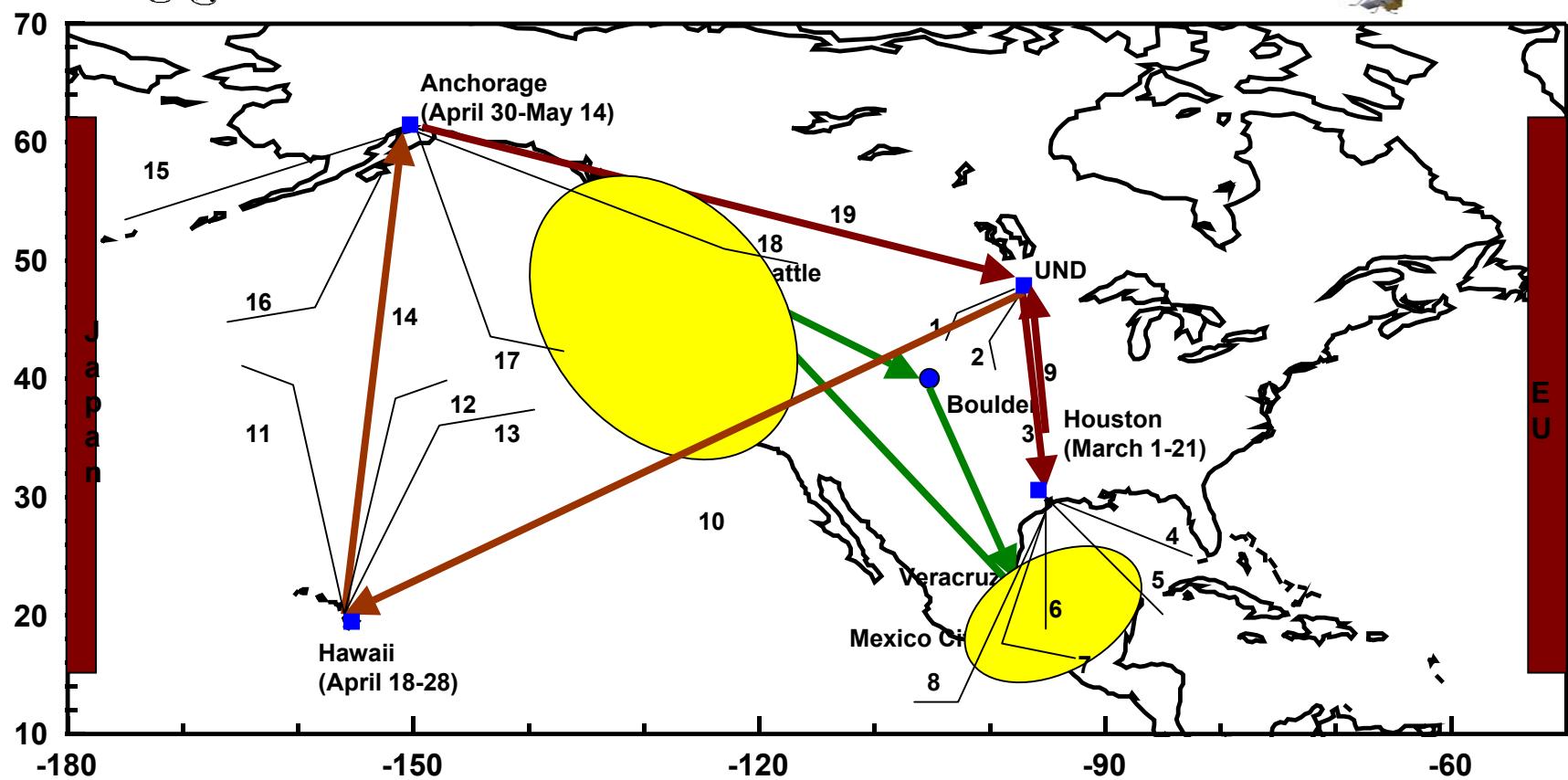
CO, O<sub>3</sub>, H<sub>2</sub>O, HCN  
(UT/LS)

O<sub>3</sub>, CO, HNO<sub>3</sub>

Satellite Platform*	Instruments	Some key data products	Vert. resol.
Aura: <a href="http://eos-aura.gsfc.nasa.gov/">http://eos-aura.gsfc.nasa.gov/</a>	TES OMI MLS	CO, CH <sub>4</sub> , O <sub>3</sub> , HNO <sub>3</sub> , NO <sub>2</sub> O <sub>3</sub> , NO <sub>2</sub> , SO <sub>2</sub> , HCHO H <sub>2</sub> O, HCN, CO	Trop col./4 km Trop column UT/LS
Aqua: <a href="http://eos-pm.gsfc.nasa.gov/">http://eos-pm.gsfc.nasa.gov/</a>	MODIS AIRS	Aerosol optical depth CO	Trop column Trop col./4 km
Terra: <a href="http://eos-am.gsfc.nasa.gov/">http://eos-am.gsfc.nasa.gov/</a>	MOPITT MISR MODIS	CO Aerosol optical depth Aerosol optical depth	Trop col./4 km Trop column Trop column
Envisat: <a href="http://envisat.esa.int/">http://envisat.esa.int/</a>	SCIAMACHY MIPAS	O <sub>3</sub> , NO <sub>2</sub> , CH <sub>2</sub> O Trace organics	Trop column UT/LS
Calipso: <a href="http://www.calipso.larc.nasa.gov/">http://www.calipso.larc.nasa.gov/</a>	CALIOP	Aerosol distribution	High resolution



## INTEX-B/MILAGRO Grand Plan for Spring 2006



**Down period: 23 Mar-11 Apr**

DC-8 transits →

Nominal C-130 operations



C-130 transits →

Operations of foreign partners  
(DLR/Falcon-20)



DC-8 locals →

**19 flights (140 flight hours):**

UND (2 test flights)

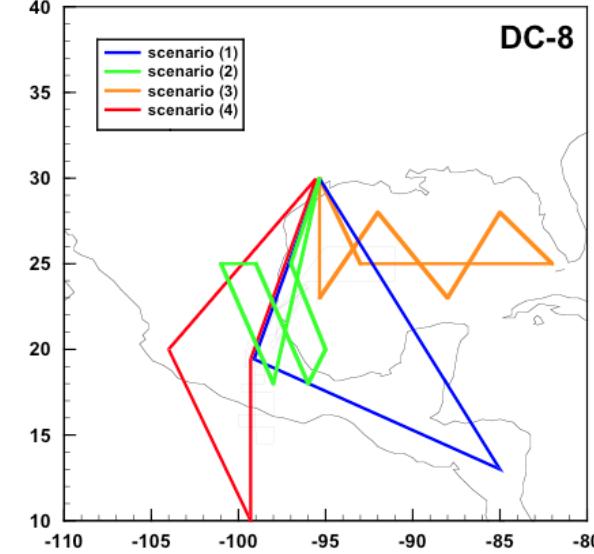
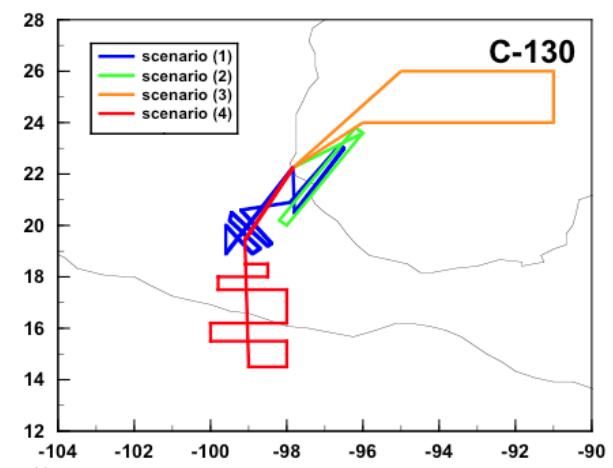
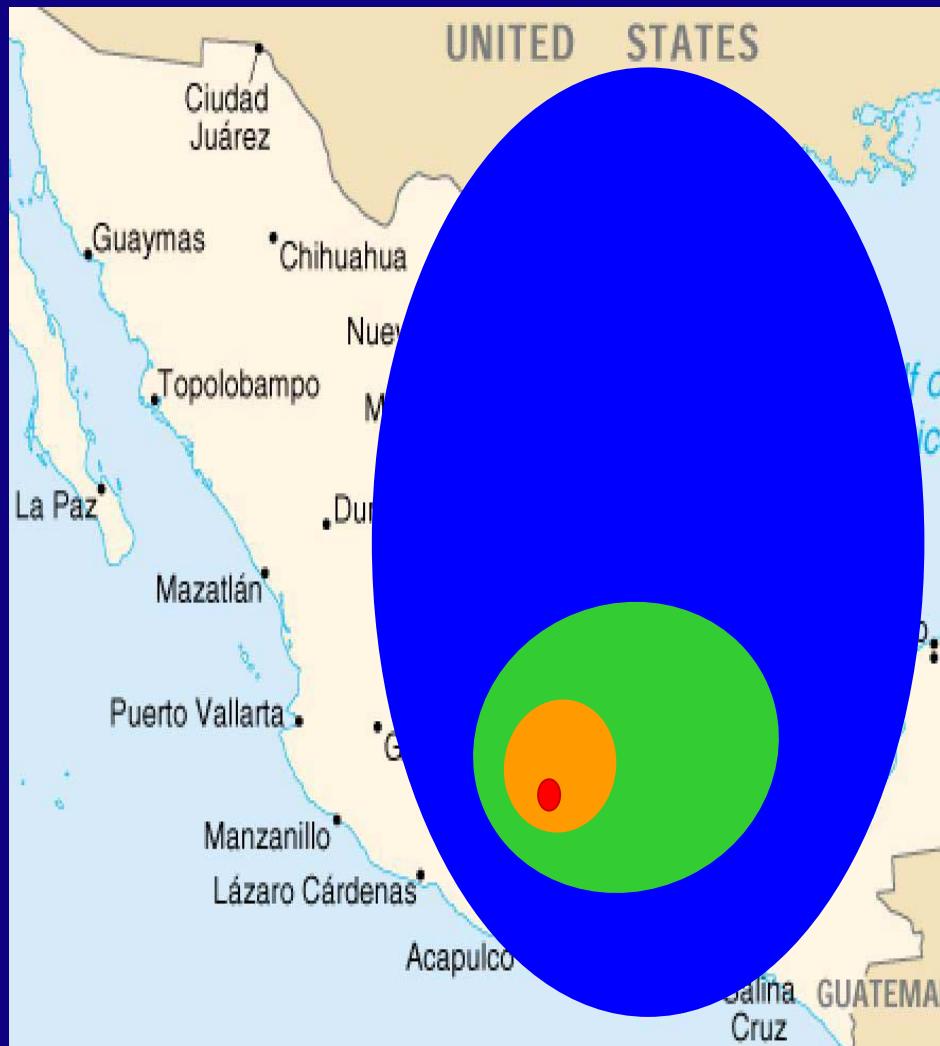
Houston (5 local flights)

Hawaii (3 local flights)

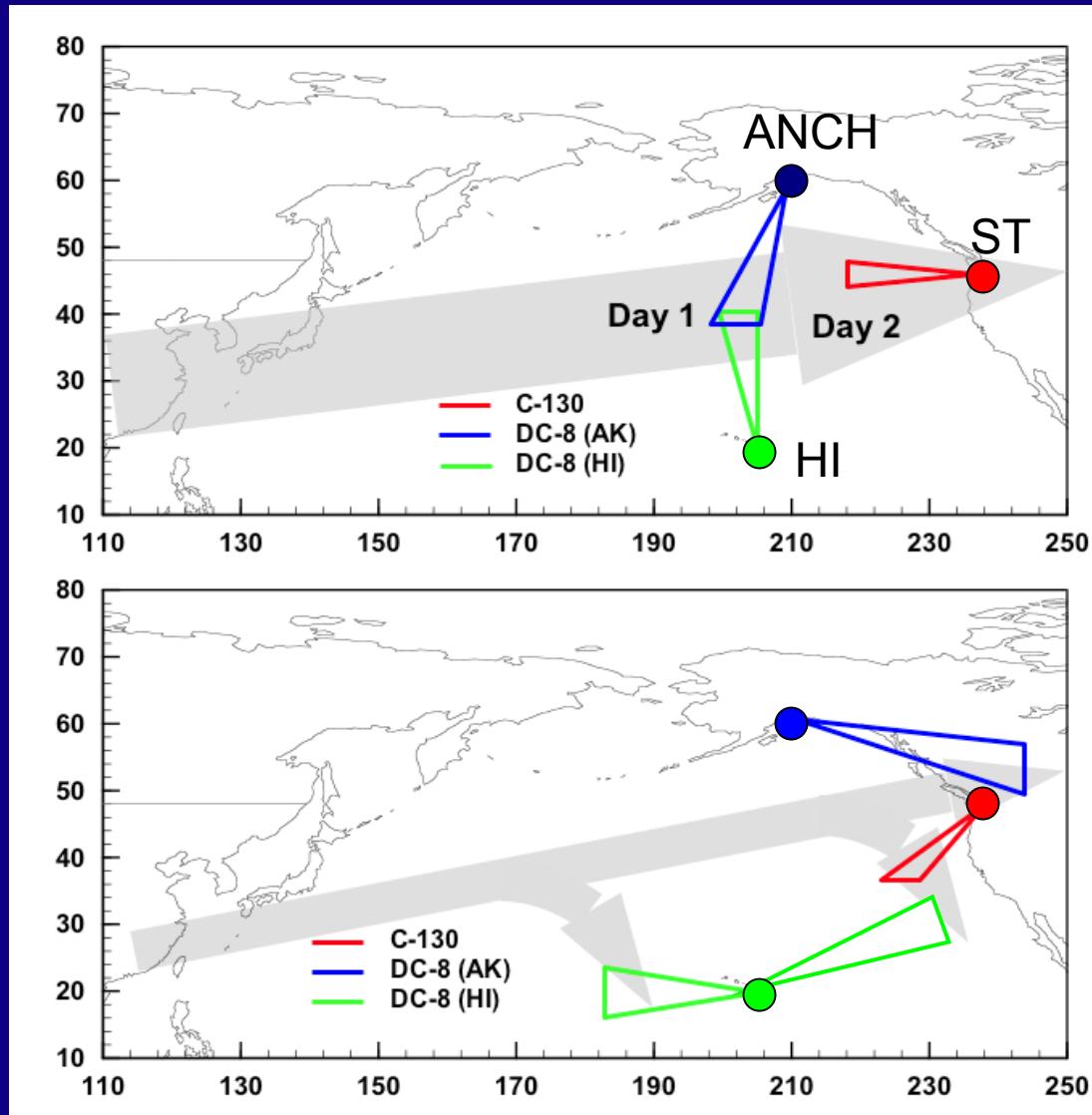
Anchorage (4 local flights)

5 transit flights

# DC-8 & C-130 Coordination in INTEX-B/Part 1



## DC-8 & C-130 Coordination in INTEX-B/Part 2



# INTEX-B Science Team

**B. Doddridge  
TCP Manager, NASA HQ**

**H. Singh, Lead Mission Scientist, NASA ARC  
W. Brune, Co-Mission Scientist, Penn State U.  
J. Crawford, Co-Mission Scientist, NASA LaRC  
D. Jacob, Co-Mission Scientist, Harvard U.**

**M. Craig, M. Gaunce, K. Shiffer  
Project managers, NASA ARC**

## **DC-8 measurements**

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M. Avery, NASA LaRC  
J. Barrick, NASA LaRC  
D. Blake, UC Irvine  
E. Browell, NASA LaRC  
A. Clarke, U. of Hawaii  
R. Cohen, UC Berkeley  
J. Dibb, U. of New Hampshire  
G. Diskin, NASA LaRC  
A. Fried, NCAR  
B. Heikes, U. of Rhode Island  
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H. Fuelberg, FSU  
(Mission meteorologist)  
W. McMillan, UMBC  
J. Moody, U. Virginia  
B. Pierce, NASA LaRC  
L. Pfister, NASA ARC  
K. Pickering, UMDCP

## **Other INTEX-B & Aura**

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C. Cantrell, NCAR  
C. Gatebe, NASA GSFC  
J. Jimenez, U. of Colorado  
J. Herman, NASA GSFC  
R. Mauldin, NCAR  
G. Mount, WSU  
P. Pilewskie, U. of Colorado  
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J. Warner, JCET/UMBC  
R. Weber GIT-EAS  
P. Wennberg, Cal Tech

# INTEX-B/DC8 Schedule\*

Location	Event	Date (2006)	Flights	Flight hours
UND(Grand Forks)	Integration	1/16-2/16	0	0
UND	Test flights	2/17-2/27	2	8
Transit to Houston	Transit	2/28	1	4
Houston Local	Science Flights	3/1-3/21	5	42
Transit to UND	Transit	3/22	1	4
Break	Break	3/23-4/11	0	0
UND Prep	Preparation	4/13-4/16	0	0
Transit to Hawaii	Transit	4/17	1	9
Hawaii Local	Science Flights	4/18-4/28	3	24
Transit to Anchorage	Transit	4/29	1	8
Anchorage Local	Science Flights	4/30-5/14	4	35
Transit to UND	Transit	5/15	1	6
Total			19	140

\*Additional flight hours, if available, will be used to add 1 flight each at Houston & Anchorage